Preliminary Abundance-Based Trend Results for Columbia Basin Salmon and Steelhead ESUs

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Table Of Contents

1 Introduction and Executive Summary

The Action Agencies (AAs) are exploring alternative methods to monitor and assess the status of Evolutionarily Significant Units (ESUs) of salmon and steelhead listed under the Endangered Species Act (ESA). In addition they want to report on the status of unlisted ESUs in the Columbia River basin. There is concern that data to accurately estimate population growth rate, a central indicator in the National Marine Fisheries Service (NOAA Fisheries) 2000 Federal Columbia River Power System (FCRPS) Biological Opinion (BiOp), is not readily available, or is not available in a timely fashion. This paper explores population indicators and tests using data that is generally available within a year of the return of adults to the spawning grounds.

We examined and selected a variety of abundance indices or estimates that appear to be readily monitored and available in a timely manner as candidates for performance indicators. Indicators include dam counts; spawners estimated from redd indices, or redd density depending on the data available for each ESU or geographic spawning aggregation within an ESU. Trends are displayed for listed ESUs, and status tests were conducted. Trend was calculated as the slope of the regression of the abundance index (log transformed) versus time. This measure of trend is used instead of lambda, because it does not require age-structure data or the reproductive success of hatchery-born spawners, which is lacking for all spawning aggregations. The test assesses whether the trend is greater at the time of the most recent data than it was during the base-period at the time of the BiOp, which we define as 1990-2000. Another test compares the geometric mean of annual wild abundance at the time of the most recent data to the 5-year geometric mean at the time of the BiOp (1996-2000). These two tests, along with a simple indicator of whether the population growth trend is positive, appear to be the only tractable assessments that can be performed with readily available data.

Thus far this reconnaissance evaluation of data assembled through 2001, ‘02, ‘03, or ‘04 indicates that the majority of listed and unlisted ESUs, and their component populations, display positive trends due to a broad-based, sharp increase in returning adults realized in recent years. Also, 16 of the 18 ESUs for which we found post-2000 data exhibit substantial increases in abundance after 2000 as compared to the 1990-2000 base period. The performance tests were positive for most, but not all, spawning aggregations that we examined.

We conclude that these abundance indices and the recommended tests are useful in assessing population status of the majority of the ESUs. These tests are simple, and require no complex models or unsupportable assumptions. Furthermore, the data needed to conduct these simple tests are readily available in a timely manner for most listed ESUs and can be regularly monitored. Note, however, that the tests are not predictions of the future, but simply track trends in past abundance.

2 Data

Datasets were selected for each ESU, both listed and unlisted (Table 1). We placed a priority on datasets that had complete information from 1990 through 2003, or, if available, 2004. Three types of trend data were used to conduct the selected tests: dam or trap counts (sometimes adjusted for hatchery fish); redd density (redds / linear mile of stream counted) and spawner abundance from redd counts or run reconstructions (for finer geographic/stock specificity). Dam counts are the only way to directly count all members of an ESU for many ESUs; and even they are not entirely accurate due to passage outside of counting hours, fallback, fish misidentification, inconsistent marking, length-at-age assumptions (used for assigning fish to adults and jacks), and estimates of the hatchery fish proportion of the run. Density of redds averaged over an entire ESU can be compared to dam counts; the relationship for the Snake River spring/summer chinook ESU, for example, is relatively consistent, and the correlation between the two is statistically significant (Figure 1). Estimates of spawner abundance in spawning areas are usually made by adjusting redd counts for hatchery fish on the spawning grounds, adults per redd estimates, length of stream surveyed, and other factors. These estimates are inaccurate at best and can be highly misleading if redd counting methodology changes drastically (i.e. the change from index area spawning surveys to a redd census for spring Chinook in the John Day basin beginning in 1999 makes comparisons to earlier estimates questionable). A few estimates of spawner abundance are made from actual spawner or carcass counts; none of these were used in the current analysis.

We used redd count information to estimate minimum adult escapement for larger spawning aggregations than the datasets we found; i.e. Middle Fork, South Fork, and upper Salmon River. In these cases we used the net adults per redd expansion factors for subbasins or streams from published sources (primarily run reconstructions). These trends were used largely to compare against the interim recovery targets set by NOAA Fisheries. We also used the best available data from different sources for many trends. In many cases the trends we used begin with total escapement estimates (adults and jacks) made from dam counts (i.e. Wind River chinook escapement = Bonneville Dam count (BON) – The Dalles Dam count (TDA) * (average Wind proportion of escapements between BON and TDA)).[1] Finally, we constructed composite trends from available datasets for many ESUs for which entire ESU estimates of abundance via dam counts are not possible. These trends should also be interpreted with caution, especially when comparing recent (post-1990) to historical abundance, since time series for individual stocks that contribute to the composite begin in different years and some series have missing data. In general, stocks were used that had complete time series between 1990 and 2000, with the expectation that data for the previous year will be available for each status evaluation conducted by the AAs. Details on the datasets we used or constructed are presented later in this document.

3 Methods

Methods used to the assess population status were taken from the draft report of the West Coast Salmon Biological Review Team (NOAA Fisheries BRT 2003). The two methods were applied to various indices of abundance, which are described above. None of the methods rely on having age structure data or knowing the relative reproductive success of hatchery-born spawners, which is unavailable for all spawning aggregations in the Columbia Basin. These measures can be applied to indices of wild-born spawner abundance or indices of total spawner abundance. The mean abundance index can be used to as a “safety net” test, a simple comparison of population abundance between the base period and current levels. The trend estimate can be used to assess whether the annual population growth rate is greater in the most recent year of data than in the base period. Note that none of these tests are predictions of future performance of the ESUs but rather measures of pre-and post-BiOp performance.

3.1 Visual Inspection of Charts

We constructed charts of each trend that show the raw numbers (almost always adults or natural origin adults), the 5 year geometric mean, and the interim target, if any was found. Trends can be easily determined by inspecting charts in many cases; this is the only “test” we used that allows comparison of recent abundance (i.e. 1990 – most recent year) to historical abundance. These charts should be interpreted with caution since methods and sources change frequently in the historical (pre-1990) data, and time series for individual stocks that are incorporated in a composite trend begin in different years. In general, time series for individual stocks in a composite are complete from 1990 through 2000.

Progress toward targets can be interpreted from charts for spawning aggregations that have a target, whether established by NOAA Fisheries or calculated as the sum of NOAA Fisheries targets for a geographic area. Again, these results should be interpreted with caution since in practically all cases the data are incomplete for the geographic unit for which the target was established. Even for stocks with a relatively restricted geographic range (i.e. Bear Valley/Elk Creeks), it is almost certain that not all redds were counted in any year, since spawning

[1] This is a fictional example. See Table 2 for examples of early escapement estimates.

censuses (as opposed to redd counts in known spawning areas) are rarely conducted. Even in cases for which "entire ESU" estimates have been made (i.e. Snake spring/summer and fall chinook), portions of the ESU have not been enumerated (i.e. escapement in a few minor tributaries below Lower Granite Dam (LGR) for spring/summer chinook and escapement of mainstem spawners and in the lower reaches of tributaries below LGR for fall chinook).

3.2 Mean Abundance Index

Average abundance of various abundance indices, are reported as a geometric mean. For the sake of comparison, geometric means were calculated for the years 1996-2000 and the years after 2000. The equation for a geometric mean is $geomean = \sqrt[k]{N_t N_{t+1} \cdots N_{t+k-1}}$, where N_t is the population index at time t, and k represents the number of observations entering the geometric mean calculation. When applied to an index of wild-born spawner abundance, the geometric mean supplies the information needed to conduct population-level safety net test. This test compares the current 5-year geometric mean of annual wild abundance to the 5-year geometric mean between 1996 and 2000.

3.3 Trends In Abundance Index

Trends in abundance indices were calculated to assess whether population abundance tends to be increasing, decreasing or staying the same. For comparison, two trends were calculated for each abundance index: the trend based on 1990-2000, and the trend based on 1990-recent data. In some cases, data were not available for 2003 or '04. In that case, trends were based on 1990-2002.

Trend was calculated as the slope of the regression of the abundance index (log transformed) versus time. One was added to the abundance index before log transforming the data to avoid taking the log of zero, which is undefined. Trend was reported as the exponential function of the estimated slope of the regression line. A trend greater than one indicates population increase, a trend less than one indicates population decrease, and a trend of 1 indicates that, on average, population numbers are not changing. The regression equation used was $\ln(N_t + 1) = \beta_0 + \beta_1 t + \varepsilon_t$, where N_t is the abundance index at time t, β_0 is the intercept regression parameter, β_1 is the slope regression parameter, and ε_t is the random error term of the regression. The regression parameter estimates, $\hat{\beta}_0$ and $\hat{\beta}_1$ are obtained through a least squares fit to the data. The trend estimate is then defined as: $\text{trend estimate} = \exp(\hat{\beta}_1)$. We stop short of developing confidence intervals for $\exp(\beta_1)$ until it can be verified that the residuals are independent and identically distributed.

This measure of trend is used instead of lambda, because it does not require age-structure data or the reproductive success of hatchery-born spawners, which is lacking for all spawning aggregations. The test assesses whether the trend is greater at the current time than it was during the base-period, which we define as 1990-2000.

3.4 Interim Recovery Targets

Interim recovery targets from Appendix A are presented in the results table and the charts of each abundance trend for reference purposes only. NOAA Fisheries established targets for the interior Columbia basin ESUs only; we did not find any targets for the Lower Columbia and Upper Willamette ESUs. We did not conduct nor do we propose any tests to measure progress toward these targets, since these tests would involve complex models and many more assumptions than the currently proposed tests. Where targets were not specified for an entire ESU, targets for individual stocks were summed to produce a target for the ESU, and are presented in Table 3, along with the data (or lack thereof) we have in hand to show progress against the targets. Whether or not this is appropriate is in question, since the BRT did not document their methodology in the source document.

4 Results

4.1 Datasets

We found over 125 datasets or spawning aggregations that could be used to calculate trend statistics for all the NOAA Fisheries ESUs, both listed and unlisted. Datasets that we used were complete from at least 1990 through 2000. Some datasets are incomplete as of this draft but are still presented in the results table. More datasets existed for the more intensely studied ESUs (i.e. SR spring/summer chinook) than the less intensely studied ESUs; very few datasets were found for the unlisted ESUs. In general the methodology for the Beamesderfer et al. 1997 “index stock”, Willamette-Lower Columbia Technical Recovery Team (WLC TRT), and Ecosystem Diagnosis and Treatment Model (EDT) processes, redd counts, and recently developed datasets (see Appendix E) was well documented; we have practically no descriptions of the methodology used to calculate the BRT datasets. Details on the datasets, sources, and their interpretation can be found in Table 2 and Appendices B through E.

Datasets were obtained from the NOAA Fisheries Biological Recovery Team (BRT 2003; Appendix B), the NOAA Fisheries Willamette/Lower Columbia Technical Recovery Team (Appendix C), the Northwest Power Planning Council (NPPC) Fish and Wildlife Program (F&WP) contract to construct run reconstructions for the Ecosystem Diagnosis and Treatment model (EDT; Appendix D), and redd surveys and escapement estimates from various sources (Appendix E). The spawning aggregations used for the tests are shown in Appendix F. 87 datasets were found that lended themselves to testing (i.e. the data appeared to be reasonable and the period from 1990-2000 was relatively complete). Some datasets were found that estimated abundance for the same spawning aggregation (i.e. Beamesderfer et al. 1997 “index stock” run reconstructions and the BRT interpretation of such); in these cases we used the original source if the time series were of identical length or the longer time series if they were not.

We only performed the tests on datasets for spawning aggregations which provide the best representation of the population status of each ESU. In most cases these were dam counts or estimates of wild spawners made from dam counts; in some cases we used a composite trend of more than one spawning population when no dam counts were available.

4.2 Results and Discussion

Charts of the 19 trends we used for the tests are shown in Figure 2. Charts of each of the remaining spawning aggregations we tested are presented in Appendix G (note that these charts were not updated for this draft). Interim targets are included on the charts for reference where they were supplied by NOAA Fisheries or calculated for larger spawning aggregates (Table 3). Comparison of the post 2000 geometric mean as compared to the interim recovery target (Table 4) demonstrates that none of the six composite trends for which we found targets meet the target in the base period (1990-2000), and of the remaining trends with targets only Imnaha River spring chinook meet the individual spawning aggregation target during the base period. Inspection of the 2001 through 2004 geometric means (where available), reveals that only Deschutes River steelhead (mid-Columbia ESU), Snake River fall chinook, Grande Ronde, Minam, and Imnaha River spring chinook, and Johnson Creek summer chinook (Snake River ESU), Asotin Creek and Joseph Creek steelhead (Grande Ronde; both Snake River ESU), and Wenatchee and Entiat steelhead (Upper Columbia ESU) pass the test during the post- BiOp period.

Two population-level tests were used in this analysis. The first test uses the BRT trend estimate to assess whether the BRT trend estimate is greater at the current time than the base-period of the trend in 2000. For this analysis, the base-period trend was calculated over 1990-2000, and the current trend was calculated over 1990-2002, 2003, or 2004. In some cases, data were not available in 2003 or ’04; in those cases we used data from 1990-2002. The test is passed if the trend at the current time exceeds the trend over the base period. We also tested whether the BRT trend is positive (i.e. greater than 1).

A third test is a safety net test, which is a simple comparison of the abundance index at the current time to the abundance index in 2000. Specifically, the test compares the geometric mean abundance index for years after 2000, to the geometric mean abundance index during 1996-2000. If the geometric mean at the current time exceeds that geometric mean over 1996-2000, then the test is passed.

Test results are presented in Table 4. Results are grouped by ESU and spawning aggregation. Results for the composite trends of each of the 18 ESUs for which we found post-2000 data are displayed in Figures 3 and 4. The results of these tests are illustrated using the percent change in the BRT trends (Table 4 and Figure 4) and the percent change in the geometric mean (Table 4 and Figure 3). When the percent change is positive, the test is passed; otherwise it is not (Table 4). We also examined whether the BRT trend at the current time was positive (Trend > 1? in Table 4). For the 18 composite trends, one for each ESU, we found that the change in mean abundance was almost always passed. The exceptions were LCR chum and LCR steelhead; however many trends in the LCR steelhead ESU composite had missing data for 2001 and none had data after 2001; and the major population of LCR chum (Gray's River) is missing for 2004, so these results will likely change with current data. The change in the BRT trend was positive for all ESUs except LCR steelhead, LCR chum, and SR sockeye. However, an ESU can pass both tests and have a negative BRT trend, as was the case with the Lake Wenatchee sockeye ESU.

In general, the spawning aggregates are the best representation of ESU abundance for stocks which are not a significant component of ocean and freshwater anadromous fisheries. For stocks which experience significant harvest in these fisheries (i.e. greater than 20% of the adult population), a better representation of total population abundance would be the total contribution to the fisheries plus spawning escapement. These stocks include most fall (ocean-type) Chinook, which have experienced significant harvest in the base period. Unfortunately, a full accounting (i.e., run reconstruction) of most of the ESUs that experience high harvest rates is not available at this time. Also, the majority of the lower river ESUs (i.e., those that spawn below Bonneville Dam) have weak or even declining populations, e.g. LCR chum and steelhead. These ESUs are the least affected by the FCRPS. Given these pattern in trends among ESUs that spawn above and below Bonneville Dam, one might theorize that marine and/or freshwater conditions not influenced by the FCRPS as recently configured are a more important factor in limiting population growth than passage through the FCRPS. However, this pattern in trends needs further testing and validation, namely comparison of trends between stocks within and outside of the Columbia River basin. Unfortunately, similar data for most species of Pacific salmon and steelhead are lacking outside the basin.

5 Tables

Table 1. Data description overview. Bold listing status indicates species is listed as either threatened or endangered under the ESA.

ESU	Species	Listing Status	Dam #s	# Spawners	Redd indices	Pop. estimates	Productivity functions
Columbia River	Chum	T	BON (Upper Gorge pop.)	Grays/Chinook, Washougal, Lower Gorge - redds; upper gorge - BON	Grays and Hamilton/Hardy only	N	R/S-BRT, Feb '03
Deschutes River Summer/Fall-run	Chinook	NW	N	TRT Run Recon. (incl. hatch.)	Y (StreamNet)	PSC Chinook TC Deschutes Falls	N?
Lake Wenatchee	Sockeye	NW	RRH, RIS	RIS – RRH (turnoff to Wenatchee R.) - WDFW	N	N?	N?
Lower Columbia River	Chinook	T	Clack., Sandy, Hood	BRT 16 pops.	9 Trends (StreamNet)	PSC Chinook TC Col. Lewis brights	R/S-BRT (10 pops)
Lower Columbia River	Coho	C	Clack., Sandy	3 trends (Busby et al. 1996)	3 trends (Clack., Sandy)	N?	Clack. (Cramer & Cramer)
Lower Columbia River	Steelhead	T	N	Σ 11 select pops. (BRT)	Sandy	N	R/S – BRT 7 pops.
Middle Columbia River	Steelhead	T	N	Σ 4 select pops. (BRT)	6 Σ over subbasin (w/in John Day)	N	N
Middle Columbia River Spring-run	Chinook	NW	Prosser, 3 Mile	9 pops. - TRT Run Recon. (incl. hatch.)	9 trends (Myers et al.)	PSC Chinook TC Col. Upriver Spring	R/S – TRT 10/02 (John Day, Yakima)
Okanogan River	Sockeye	NW	WEL	Expanded spawning ground counts - BC Fisheries?	Y	N?	N?
Snake River	Sockeye	E	ICH-LGR	Redfish L Weir; Sawtooth Weir (recent)	N	N?	N
Snake River Basin	Steelhead	T	ICH-LGR	Σ 9 pops. Incl. LGR aggregate (BRT)	Imnaha	TAC, A-B run only (Al where is this?)	A. Byrne in press
Snake River Fall-run	Chinook	T	ICH-LGR	BRT nat. origin above LGR	Yes – IDFG/NPT/ODFW	N	R/S-BRT, 02/03
Snake River Spring/Summer-run	Chinook	T	ICH-LGR	Nat. sp & su @ LGR; Σ 14 index pops. (BRT); Tucannon – TRT Run Recon.	Yes – IDFG/NPT/SBT	PSC Chinook TC Col. Upriver Spring	R/S-BRT, 02/03; TRT 10/02 (Up, MF, SF Salmon);
Upper Columbia River	Steelhead	E	WEL	Wenatchee/Entiat + Methow/Okanogan	Methow	N	R/S-BRT, Feb '03
Upper Columbia River Spring-run	Chinook	E	PRD-WEL	3 pops. – Wenatchee, Methow, Entiat	9 trends	PSC Chinook TC Col. Upriver Spring	R/S-BRT (3 pops), 02/03, WEN/ENT index
Upper Columbia River Summer/Fall-run	Chinook	NW	PRD-WEL	8 trends (Myers et al.)	5 trends (Myers et al.)	PSC Chinook TC Col. Upriver Summer & URB	N?
Upper Willamette River	Chinook	T	WILF	BRT – Clack., N Santiam, McKenzie	3-4 Trends (StreamNet)	N	N
Upper Willamette River	Steelhead	T	WILF, Foster, Minto	Σ 9 select pops. (BRT)	4 trends (BRT)	N	N

Table 2. Detailed description of information sources, methods, and assumptions used to estimate the adult or total (adult and jack) spawner return run to selected Columbia and Snake River tributaries.

Tributary / Attribute / Time period	Information sources	Methods, assumptions, or comments
Lower Columbia Spring Chinook		
Wind River EDT Stock[2]		
Total run to the river		
1960-1965	Beamesderfer et al. 1997 in Marmorek et al. 1998.	Original source or methods unknown.
1966-1969	ODFW and WDFW, 2000 (for passage counts at Bonneville Dam); Petit, 2002 (for 1970-1977 Wind River run to the river estimates).	Average of the proportion: Wind River run divided by (Bonneville Dam count less Zone 6 harvest) for years 1970-1977 (equals 0.053), multiplied by each year's Bonneville Dam count for 1966-1969.
Jack and adult run to the river		
1970-2001	Petit, 2002.	WDFW agency database. 2001 estimate is preliminary.
Little White Salmon River EDT Stock		
Jack and adult run to the river		
1970-2001	Petit, 2002.	WDFW agency database. 2001 estimate is preliminary.
White Salmon River EDT Stock		
Jack and adult run to the river		
1986-2001	Petit, 2002.	WDFW agency database; Jacks and adults are summed from Table 17 (escapement) and Table 18 (sport harvest). 2001 estimate is preliminary.
Hood River BRT Stock		
Total run to the river		
Pre-1963	None.	No escapement estimates are available; adult monthly salmon catch estimates summed over March through July for each year during 1956-1962 range from 0 to 29 (based on angler-returned harvest cards for steelhead and salmon, adjusted for non-response bias). Reported catches could include species or runs other than spring chinook salmon.
1963-1971	ODFW and CTWSRO 1990 (for dam passage counts); Unpublished sport harvest statistics, ODFW Fish Division.	Sum of Powerdale Dam passage counts and sport harvest of adult salmon (adjusted sums of monthly catches as noted above).
1972-1989	None.	No escapement estimates are available; sport catches of adult spring chinook salmon during years with open seasons ranged from 0 to 41 (based on annual sport catch statistics from angler-returned harvest cards for steelhead and salmon).

[2] See attached documentation of EDT Task 1. Development of Spring and Summer Chinook Biological Information for EDT Validation

Tributary / Attribute / Time period	Information sources	Methods, assumptions, or comments
Hood River BRT Stock		
Adult return to the river		
1989-1991	Beamesderfer et al. 1997 in Marmorek et al. 1998; U.S. versus Oregon Technical Advisory Committee, 1997.	The average ratio of the estimated sport catch (based on punch card returns) below Powerdale Dam to Powerdale Dam counts for 1992-1994 (1.33) is used to expand below Powerdale sport catch estimates in 1989-1991 for an escapement estimate. Powerdale Dam passage was not enumerated during those years.
Jack and adult return to the river		
1992-1998	ODFW, 2001; Unpublished sport harvest statistics, ODFW Fish Division; Olsen et al. 1994; Olsen and French, 1996; Olsen and French, 1998.	Sum of Powerdale Dam passage counts and sport harvest estimates. For years with no creel surveys (1992-1995,1997), sport catch statistics from angler-returned harvest cards are used to estimate adult harvest. Jack dam counts are expanded to include harvest, assuming adult catch rates are the same as jack catch rates.
1999-2003	Personal communication, 11/20/2001, E. Olsen, ODFW, The Dalles, updated by pers. comm. 8/2004	Sum of Powerdale Dam passage counts and sport harvest creel estimates. (2001 estimate is preliminary).
WLC TRT[3] Spring Chinook Stocks		
Cowlitz, Kalama, Lewis, and Sandy Rivers – see attached Willamette/Lower Columbia TRT documentation		
WLC TRT Fall Chinook Stocks		
Fourteen Early, Mid- and Late Fall Run Stocks (Sandy River Early Fall; Big White Salmon, Clackamas, Coweeman, Cowlitz, East Fork Lewis, Elochoman, Grays, Kalama, Mill Creek, Washougal, Wind, Fall; Lewis, Sandy Late Fall) – see attached Willamette/Lower Columbia TRT documentation		

Tributary / Attribute / Time period	Information sources	Methods, assumptions, or comments
Lower Columbia Chum		
WLC TRT Chum stocks		
Hamilton and Hardy Creeks		
Adult spawners		
1967-2000	Willamette/Lower Columbia TRT	Total adults - see attached Willamette/Lower Columbia TRT documentation; one stock not used since it overlaps the Hamilton/Hardy stock.
2001-2003	Personal communication, 8/11/2003, Nancy Uusitalo, USFWS Columbia River Office, Vancouver WA, updated by , S. Lorr, USFWS Vancouver WA, pers. comm. 10/2004	Total adults (expansion from peak index count)
Grays River		
Adult spawners		
1959-2001	Lower Columbia Washington Run Reconstructions	Total natural adult escapement to mainstem and tributaries
2002-2003	Grays River Chum HGMP	Peak spawners (2003 missing)
Chinook River		
Adults		
2002-2003	Grays River Chum HGMP	Approximate return to Sea Resources hatchery trap (reintroduced population)

[3] Willamette River/Lower Columbia Technical Recovery Team URL: http://www.nwfsc.noaa.gov/cbd/trt/viability_salmoniddata.htm

Tributary		
Attribute		
Time period	Information sources	Methods, assumptions, or comments
Lower Columbia Steelhead		
WLC TRT Winter Run Steelhead Stocks		
East Fork Lewis, Hood, Kalama, Washougal, Wind Summer; Coweeman, East Fork Lewis, Hood, Kalama, North Fork Toutle, Sandy, South Fork Toutle, Washougal Winter run total adults - TRT dataset summer + winter run stocks; time series start & stop almost at random; use numbers with caution. Generally complete from 1990 – 2000; see attached Willamette/Lower Columbia TRT documentation		
Lower Columbia Coho		
BRT coho stocks		
Adults		
1957-2003	D. Cramer, Doug_Cramer@pgn.com, Portland General Electric (PGE), Portland OR, pers. comm. 6/2003, updated by pers. comm.. 5/2004	Adult counts at North Fork Dam (Clackamas River) and Marmot Dam (Sandy River)
2004	Portland General Electric (PGE) 2004	Incomplete until 11/15; not used. Adult counts at North Fork Dam (Clackamas River) and Marmot Dam (Sandy River)
Upper Willamette Spring Chinook		
WLC TRT Spring Chinook Stocks		
Clackamas River		
Adults		
1958-2002	D. Cramer, Doug_Cramer@pgn.com, Portland General Electric (PGE), Portland OR, pers. comm. 5/2003	North Fork dam total adults
2003-2004	Portland General Electric (PGE) 2004	North Fork dam total adults
McKenzie River		
Adults		
1970-2001	Leaburg dam counts; see attached Willamette/Lower Columbia TRT documentation	Leaburg dam total adults
2002-2003	Personal communication, 8/5/2003, J. Ziller, ODFW, Springfield OR, updated by J. Firman, ODFW, julie.firman@oregonstate.edu. pers. comm. 7/8/2004	Leaburg dam total adults
Upper Willamette Steelhead		
Willamette Falls Dam Winter Steelhead Stock		
Willamette River @ Willamette Falls (Sullivan Dam)		
Winter Adults		
1950-2001	D. Domina, PGE, pers. comm.. 7/31/2003	Willamette Falls (Sullivan Dam fish ladder) total winter adult count
2002-2003	J. Firman, ODFW, julie.firman@oregonstate.edu. Pers. Comm.. 7/8/2004	Willamette Falls (Sullivan Dam fish ladder) total winter adult count

Tributary / Attribute / Time period	Information sources	Methods, assumptions, or comments
Deschutes River Summer/Fall Chinook Stock		
ESU Totals		
Total run to the river		
1977-2003	S. Pribyl, steve.pribyl@state.or.us, ODFW, The Dalles, pers. comm. 5/2004	Run size of adult fall chinook salmon in the Deschutes River from Table 29

Mid- Columbia Spring Chinook

Tributary / Attribute / Time period	Information sources	Methods, assumptions, or comments
Klickitat River BRT Stock		
Total run to the river		
1954-1965	ODFW and WDFW, 2000 (for passage counts at Bonneville Dam); Update and revisions to Beamesderfer et al. 1997 in Marmorek et al. 1998, provided by O. Langness, WDFW, 6/6/2000 (for 1966-1976 run to the river estimates); and Petit, 2002 (for 1977 Klickitat River run to the river estimate).	Average of the proportion: Klickitat River run divided by (Bonneville Dam count less Zone 6 harvest) for years 1966-1977 (equals 0.021), multiplied by each year's Bonneville Dam count for 1954-1965.
1966-1976	Update and revisions to Beamesderfer et al. 1997 in Marmorek et al. 1998, provided by O. Langness, WDFW, 6/6/2000.	Update and revisions are completion products for Bonneville Power Administration Intergovernmental Agreement 96BP90134.
Jack and adult return to the river		
1977-2001	Petit 2002	WDFW agency database. Two-year-old precocious males reported in Petit (2002) are not included in this summary. 2001 estimate is preliminary.
Deschutes River Spring Stock		
Total run to the river		
1977-2003	S. Pribyl, steve.pribyl@state.or.us, ODFW, The Dalles, pers. comm. 5/2004	Wild adults trapped at Pelton and Warm Springs hatcheries from Table 14 + wild adult harvest from Table 16

Tributary / Attribute / Time period	Information sources	Methods, assumptions, or comments
John Day River BRT Stock		
Total run to the river (through 1958)		
1954-1958	ODFW and WDFW, 2000 (for passage counts at Bonneville Dam); Beamesderfer et al. 1997 in Marmorek et al. 1998 (for methods for a run reconstruction for John Day Basin spring chinook salmon); Run reconstruction for John Day spring chinook salmon prepared for Northwest Power Planning Council as part of an EDT validation project. in progress. Contract C2002-021 between Pacific Northwest Electric Power and Conservation Planning Council and ODFW.	Average of the proportion: John Day River run divided by (Bonneville Dam count less Zone 6 harvest) for years 1959-1967 (equals 0.026), multiplied by each year's Bonneville Dam count for 1954-1958.
Jack and adult run to the river (adults used from 1959-2001)		
1959-2001	Run reconstruction for John Day spring chinook salmon prepared for Northwest Power Planning Council as part of an EDT validation project. in progress. Contract C2002-021 between Pacific Northwest Electric Power and Conservation Planning Council and ODFW.	A detailed description is presented separately. The run to the river estimate is based on index redd counts in three key spawning areas expanded by area and fish per redd. The estimate includes in-river harvest and pre-spawning mortality. Surveys from 1999-2002 are more intensive than in the past so the redd counts may be inflated, although this is not noted in the documentation supplied by the BRT.
Redd density		
1959-2003	Carmichael et al. 2001, updated for 2001-2003 by pers. comm. W. Wilson, wwilson@centurytel.net, ODFW John Day, 5/2003 & 8/2004	Used index area redd counts expanded by a constant adults/redd factor. Surveys from 1999-2002 are more intensive than in the past so the redd density may be inflated.
Umatilla River BRT Stock		
Jack and adult run to the river (used adults)		
1988-1989	CTUIR and ODFW, 1990a.	Hatchery jacks and adults trapped at Threemile Dam. Natural-origin spring chinook salmon were extirpated from the basin. Re-introduced fish from hatchery production first began to return as adults in 1988.
1990-2001	Draft Umatilla Subbasin/Willow Creek Subbasin Summary, 8/3/2001, prepared for NWPPC., updated by D. Chess, ODFW, Hermiston, OR, pers. comm. 12/3/2001	Threemile Dam passage counts plus harvest downstream of the dam.
Walla Walla River BRT Stock		
Jack and adult run to the river (used adults)		
2000-2001	CTUIR and ODFW, 1990b; Draft Walla Walla Subbasin Summary, 8/3/2001, prepared for NWPPC; personal communication, P. Kissner, CTUIR, 4/10/2002.	Natural-origin spring chinook salmon were extirpated from the basin. Adults and jacks trapped at Ringgold Springs Hatchery were outplanted to the Walla Walla Basin during the 2000 and 2001 return years. These outplants are assumed to be accounted for in the Ringgold hatchery returns (see below) and are not added into the total tributary escapement estimates. If outplants successfully reproduce, future jack and adult returns to the Walla Walla Basin will need to be included in estimates of mainstem tributary escapements.

Tributary / Attribute / Time period	Information sources	Methods, assumptions, or comments
Yakima River BRT Stock		
Total run to the river		
1954-1956	Mongillo and Falconer, 1980 as cited in Howell et al. 1985.	Interpolated from Figure 2, page 394B in Howell et al. 1985 citing Mongillo and Falconer, 1980. Assumes Y-axis origin is zero rather than the 3,000 value printed in the figure.
Jack and adult run to the river (used adults)		
1957-1959	Fast et al. Unknown date (for adult return estimates); Personal communication, B. Bosch, Yakama Nation Fisheries Resource Management, Yakima, Washington, 3/2002 (for river run estimates by adults and jacks, 1982-2001).	Adults interpolated from Figure 2, page 26 in Fast et al. Unknown date; The average jack/adult ratio for the Yakima Basin from 1982-2001 (0.123) is used to estimate jack returns.
Yakima River BRT Stock		
1960-1981	Fast et al. Unknown date; Matylewich, undated in Schaller et al. 1992; ODFW and WDFW, 2000 (for jack and adult passage counts at McNary Dam).	Adults interpolated from Figure 2, page 26 in Fast et al. Unknown date were cross referenced with numerical values in Matylewich (undated). The relative difference from both sources averages 0.005, and Matylewich (undated) is used. The jack/adult ratio for each year for McNary Dam is used to estimate Yakima Basin jacks.
1982-2001	Bosch 2001; Personal communication, B. Bosch, Yakama Nation Fisheries Resource Management, Yakima, Washington, 3/2002 (for river run estimates by adults and jacks, 1982-2001).	Yakama Nation Fisheries Resource Management spring chinook salmon run reconstruction dataset.

Snake Spring/Summer Chinook

Tributary / Attribute / Time period	Information sources	Methods, assumptions, or comments
Tucannon River BRT Stock		
Total run to the river (used through 1978)		
1969-1984	Gallinat et al. 2001 (for redd counts and fish per redd); Schwartzberg and Roger, 1986 (for historic redd counts) and Howell et al. 1985 (for historic redd counts and harvest estimates).	For the EDT project conversion rate estimates, an approximation of escapement potential is estimated by expanding historic redd counts to other spawning areas with a factor of 6.7, and expanding total potential redds by 2.6 fish per redd. Adult harvest during open seasons (1969-1973) estimated from punch cards is added to approximate a total potential run to the river.
A consistent time series of redd counts is available for the reach from Tucannon Camp Ground to Cow Camp Bridge (except 1978 and 1979). Redd counts in this reach represent approximately 15 percent of total redds during the 2000 return year (Table 7 in Gallinat et al. 2001). The annual fish per redd ratio averages approximately 2.6 for the period 1985-2000 (Table 13 in Gallinat et al. 2001). For the two years with no redd counts, the 1977 approximate potential return was projected through 1978 and 1979 at the proportional rate of change of McNary Dam passage counts. Cautions to consider regarding temporal changes in spawning distribution are described in Gallinat et al. 2001). The estimates described here follow generally an annual 200 adult escapement level after 1971 and remain below an average 2,400 fish per year escapement prior to 1953 reported in WDF et al. (1990).		
Jack and adult run to the river		
1979-2002	Personal communication, M. Gallinat, gallimpg@dfw.wa.gov, WDFW, Dayton, 5/2003	WDFW Tucannon River spring chinook escapement dataset.

Tributary / Attribute / Time period	Information sources	Methods, assumptions, or comments
Lower Granite Dam		
Total adult count		
1975-2001	PSC Chinook TAC data - S. Kiefer, skiefer@idfg.state.id.us, IDFG Boise, pers. comm. 05/2003	Unknown methods; generally use run timing to distinguish spring/summer/fall, length criteria to distinguish jacks and adults, and fin clips (recent) or hatchery returns (historical) plus some unknown prespawn mortality to distinguish hatchery/wild.
Wild adult count		
1962-1978	Petrosky et al. 2001	Spawners included wild- and hatchery-origin fish spawning in tributaries. The uppermost dam changed during this era as new projects were added: Ice Harbor in 1961, Lower Monumental in 1969, Little Goose in 1970, and Lower Granite in 1975. Spawner (parent) and Dam counts used to derive spawner (S) estimates included data for brood years 1962–1997. The dam counts are total numbers of adult (ages 4–5) spring and summer chinook for wild- and hatchery origin adults combined. The wild component was estimated by subtracting tributary harvest of wild fish and the total hatchery run size from the combined wild and hatchery dam count. Prespawning survival rate (=0.8).
1979-2002	PSC Chinook TAC data - S. Kiefer, skiefer@idfg.state.id.us, IDFG Boise, pers. comm. 05/2003	Unknown methods; generally use run timing to distinguish spring/summer/fall, length criteria to distinguish jacks and adults, and fin clips (recent) or hatchery returns (historical) plus some unknown prespawn mortality to distinguish hatchery/wild.
2003	None	Estimate using PSC Chinook TAC methods and 40% hatchery fraction at LGR from S. Kiefer, skiefer@idfg.state.id.us, IDFG Boise, pers. comm. 08/2004
Salmon, Grande Ronde, and Imnaha Rivers		
Natural origin adult spawners (Index Stocks)		
1957-1995	Beamesderfer et al. 1997 in Marmorek et al. 1998	General run reconstruction methods using, index and extensive redd counts expanded to spawners, estimates of hatchery fish on the spawning grounds.
Redd Density		
1957-2002	Paulsen and Fisher In press	Redd survey information (redds counted and kilometers surveyed) was obtained from various sources for the spawning streams (P. Keniry, pkeniry@eou.edu, ODFW, 107 20th Street LaGrande OR 97850, personal communication, 2002, 2003 [Grande Ronde and Imnaha basins] and Hassemer 1993; Elms-Cockrum 2001, updated by S. Keifer, skiefer@idfg.state.id.us, IDFG, 600 S Walnut St. Boise ID 83707, personal communication, 2002, 2003 [Salmon Basin]). Redds were total redds from the best available survey, from both index and non-index areas
2003		Same methods as Paulsen and Fisher In press
Minimum Total Spawners		
1957-2002	Redd survey information from above sources; total redds for index and non-index areas expanded by net redd-adult ratio from Beamesderfer et al. 1997	.
BRT Stocks – Lemhi R., Pahsimeroi R., Minam R., Catherine Cr., Wenaha R.		
Varies	Assumed from Beamesderfer et al. 1997 in Marmorek et al. 1998 for most years; post-1995 are from an unknown source.	General run reconstruction methods using, index and extensive redd counts expanded to spawners, estimates of hatchery fish on the spawning grounds.

Tributary / Attribute / Time period	Information sources	Methods, assumptions, or comments
Snake River Fall Chinook		
Lower Granite Dam		
Total wild return over the dam		
1975-1985	BRT spreadsheet	methods not specified
1986-2003	Columbia River Compact 2004	methods not specified
Snake River Sockeye		
Various Points		
Total run		
1954-1966	BRT spreadsheet.	Redfish Lake outlet trap adult counts
1967-1974	BRT spreadsheet.	Ice Harbor Dam adult counts
1975-2002	NOAA Fisheries Biological Recovery Team. 2003	Sawtooth Hatchery trap adult counts
2003-2004	IDFG	Sawtooth Hatchery trap adult counts; 2004 is trap count + adults netted below the weir
Snake River Steelhead		
Lower Granite Dam		
A & B Run Summer Steelhead		
1980-1997	BRT spreadsheet; CRFMP Technical Advisory Committee (TAC)	Estimates of wild adult A & B-run summer steelhead by length class
1998-2001	BRT spreadsheet; P. Dygert, NOAA Fisheries, Montlake WA	Estimates of wild adult A & B-run summer steelhead by length class
2002-2003	S. Marshall, smarshal@idfg.state.id.us, IDFG Boise, pers. comm. 8/27/2004	Estimates of wild adult A & B-run summer steelhead by length class
Mid-Columbia River Steelhead		
BRT Stocks		
Composite adult run		
1980-2001	BRT spreadsheet	Composite of 4 BRT runs: Unknown, Yakima, Umatilla, and Touchet (from Joe Bumgarner)
Other Stocks		
Touchet River adults		
1987-2002	Joe Bumgarner, bumgajdb@dfw.wa.gov, WDFW Dayton WA, pers. comm. 05/2003	Estimates of spawning adults from trap and redd count data
Deschutes River wild adults		
1978-2002	S. Pribyl, steve.pribyl@state.or.us, ODFW, The Dalles, pers. comm. 5/2004	Table 37. Estimated number of steelhead that migrated past Sherars Falls, by run year.

Tributary / Attribute / Time period	Information sources	Methods, assumptions, or comments
Upper Columbia River Spring Chinook		
BRT Stock		
Composite adult run		
1960-2003	BRT spreadsheet update	Methow + Wenatchee + Entiat all spawners
Upper Columbia River Summer/Fall Chinook		
Priest Rapids Dam		
Adult dam count		
1960-2003	Columbia River DART	Adult Chinook dam count for summer and fall counting periods
Upper Columbia River Steelhead		
Priest Rapids Dam		
Estimated wild adults counted at dam		
1986-2003	BRT spreadsheet update	Priest Rapids Counts; used since wild steelhead not updated by NOAA Fisheries; WDFW proportion wild since 1986 only
Lake Wenatchee Sockeye		
Columbia River turnoff		
Lake Wenatchee turnoff from the mainstem Columbia		
1960-2004	Columbia River DART	Rock Island minus Rocky Reach adults and jack count
Okanagan Sockeye		
Wells Dam		
Adults counted at dam		
1960-2004	Columbia River DART	Dam count used due to availability over BC spawning ground expansions

Table 3. NOAA Fisheries interim recovery targets (Lohn 2002), and types of data we have on hand to address progress toward those targets. Shaded targets are sums of targets for spawning aggregations within the geographic area that were in the original document.

Geographic Spawning Aggregations		Interim Abundance Targets		Data to Address Targets			
ESU/Spawning Aggregation	Index Areas	Spawning Aggregation	Index Areas	Dam Count	# Spawners	Redd Census	Redd Index
Upper Columbia Spring Chinook ESU		6,250		PRD?	Σ4 pops.?	Y?	Y
Methow River	Methow	2,000	2,000	?	BRT est.	Y	
Entiat River	Entiat	500	500		BRT est.	Y	
Okanogan River		none		Y	N	N	N
Wenatchee River	Wenatchee	3,750	3,750		BRT est.	Y	
Snake River Spring/Summer Chinook ESU		41,900		LGR	BRT/TAC est.	N	Y
Tucannon River		1,000		N	TRT est.	Y	Y
Grande Ronde River		2,000		N	N	N	Σ 9 indices
	Minam		439	N	BRT est.	Y	N
Imnaha River		2,500		N	N	N	Σ 3 indices
	Mainstem		802	N	BRT est.	N	Y
Lower Mainstem tribs.		1,000		N	N	N	Σ 2 indices
Salmon River		35,400		N	N	N	Y
Little Salmon River Basin		1,800		Rapid R. weir	N	N	N
Mainstem Salmon small tribs.		700		N	N	N	N
South Fork Salmon (Sum.)		9,200		N	Σ 2 BRT est.	N	Σ 4 indices
	Johnson Creek		288	N	BRT est.	N	Y
Middle Fork Salmon		9,300				R. Thurow, USFS IRC	
	Bear Valley/Elk		911	N	BRT est.	N	Y
	Marsh Creek		426	N	BRT est.	N	Y
Mainstem Tributaries (Middle Fork to Lemhi)		700		N	N	N	N. Fk. Salmon
Lemhi River		2,200		N	BRT est.	N	Σ 2 indices
Pahsimeroi (Sum.)		1,300		Weir	Weir - Hatchery	N	Y
Mainstem tribs. (Sum.) Lemhi to Redfish Lake Creek		2,000		N	N	N	Σ 2 indices
Mainstem tribs. (Spr.) Lemhi to Yankee Fork		2,400		N	N?	N	Σ 2 indices
Upper East Fork tribs. (Spr.)		700		N	N?	N	Y
Upper Salmon Basin (Spr.)		5,100		N	Valley Cr. BRT est.	N	Σ 3-4 indices
Snake River Fall Chinook ESU		2,500		LGR	BRT est.	Y	Y
Snake River Sockeye ESU		1000 in one lake; 500 per year in second lake		Sawtooth weir	Redfish L. weir	N	N
Snake River Steelhead ESU		53,700		LGR	LGR TAC	N	Approx. 42 streams
Tucannon River		1,300		N	BRT est.	N	Y?
Asotin Creek		400		N	BRT est.	N	Y

Table 3. (Continued).

Geographic Spawning Aggregations		Interim Abundance Targets		Data to Address Targets			
ESU/Spawning Aggregation	Index Areas	Spawning Aggregation	Index Areas	Dam Count	# Spawners	Redd Census	Redd Index
Snake River Steelhead ESU							
Grande Ronde River		10,000					18 streams
Lower Grande Ronde R.		2,600		N	BRT est. (1 stream)?	N	1 stream?
Joseph Creek		1,400		N	BRT est. (9 streams)	N	9 streams
Middle Fork		2,000		N	BRT est. (3 streams?)	N	3 streams in Wallowa?
Upper Mainstem Grande Ronde R.		4,000		N	BRT est. (5 streams?)	N	5 streams?
Imnaha River		2,700		N	BRT est. (6 streams)	N	6 streams
Clearwater River		17,700		Lewiston Dam (1971)			
Mainstem Clearwater R.		4,900		N	N	N	N
South Fork Clearwater R		3,400		Crooked R Weir	N	N	N
Middle Fork Clearwater R		1,700		Fish Cr. Weir	N	N	N
Selway R.		4,900		N	N	N	N
Lochsa R.		2,800		N	N	N	N
Salmon River		21,600					
Lower Salmon R.		1,700		N	N	N	N
Little Salmon R.		1,400		N	N	N	N
South Fork Salmon R.		4,000		N	N	N	N
Middle Fork Salmon R.		7,400		N	N	N	N
Upper Salmon R.		4,700		N	N	N	N
Lemhi R.		1,600		N	N	N	N
Pahsimeroi R.		800		N	N	N	N
Upper Columbia Steelhead ESU		5,500		N	Σ BRT est.	N	2 trends
Methow River		2,500		WEL	BRT (2 trends)	N	Y
Entiat River		500		N	BRT (w/ Wenatchee)	N	N
Okanogan River		none		WEL	WDFW?	N	Y?
Wenatchee River		2,500		N	BRT (w/ Entiat)	N	Disc.
Middle Columbia Steelhead ESU		55,400		N	N	N	4 areas
Yakima River		10,500			BOR (-2000)		
Satus R./Toppenish Cr.		2,400		N	N	N	N
Naches R.		3,400		N	N	N	N
Mainstem Yakima R. (Wapato to Roza)		1,800		N	N	N	N
Mainstem Yakima R. (above Roza)		2,900		N	N	N	N

Table 3. (Continued).

Geographic Spawning Aggregations		Interim Abundance Targets		Data to Address Targets			
ESU/Spawning Aggregation	Index Areas	Spawning Aggregation	Index Areas	Dam Count	# Spawners	Redd Census	Redd Index
Middle Columbia Steelhead ESU				N	N	N	4 areas
Klickitat River		3,600		N	N	N	N
Walla-Walla River		2,600		N	N	N	N
Umatilla River		2,300		3 Mile Dam?	N	N	N
Deschutes River (below Pelton Dam complex)		6,300		Sherars Falls	N	N	Y
John Day River		9,800					
North Fork John Day R.		2,700		N	TRT est.	Y	Y
Middle Fork John Day R.		1,300		N	TRT est.	Y	Y
South Fork John Day R.		600		N	N	N	N
Lower John Day R.		3,200		N	N	N	N
Upper John Day R.		2,000		N	TRT est.	Y	Y

Table 4. Geometric mean abundance and trends for the 18 ESUs in the Columbia River basin. Descriptions of the columns follow the table. (LCR = Lower Columbia River; SR = Snake River; MCR = Mid-Columbia River; UCR = Upper Columbia River). Note that two ESUs did not have enough post-2000 data to calculate percent change or perform the BiOp test analogues.

Trend No.	ESU	Aggregation	Type	Most Recent Year	Interim Target	Geomean (1996-2000)	Geomean (2001-recent)	Trend Slope (1990-2000)	Trend Slope (1990-recent)	% change in geomean	% change in trend	Change in trend +?	Change in mean +?	Trend > 1?
1	LCR Chinook	Lower Columbia ESU	Best Total Spawners	2001		11,135	41,450	0.97	1.03	272%	6.6%	True	True	True
2	MCR Spring Chinook	Mid-Columbia ESU	Best Total Spawners	2001		12,728	45,143	1.00	1.06	255%	5.5%	True	True	True
3	SR Spring Chinook	Snake River ESU	Wild Adults	2003	41,900	5,186	33,581	0.97	1.14	548%	17.1%	True	True	True
4	SR Fall Chinook	Above Lower Granite Dam	Wild Adults	2003	2,500	694	3,462	1.16	1.24	398%	8.0%	True	True	True
5	SR Sockeye	Snake River ESU	Adults	2004	1,500	4[1]	14	1.26	1.22	211%	-3.7%	False	True	True
6	SR Steelhead	A & B Runs above Lower Granite Dam	Wild Adults	2003	53,700	10,694	37,784	1.00	1.10	253%	9.3%	True	True	True
7	UCR Spring Chinook	Upper Columbia ESU	Adults	2003	6,250	436	4,959	0.84	1.05	1038%	24.8%	True	True	True
8	UCR Steelhead	Upper Columbia River ESU	Wild Adults	2003	5,500	1,146	3,643	0.97	1.06	218%	9.2%	True	True	True
9	Deschutes R Summer/Fall Ch	Deschutes River	Wild Adults	2003		9,137	12,773	1.10	1.10	40%	0.1%	True	True	True
10	MCR Steelhead	Mid-Columbia River Steelhead ESU Composite	Wild Adults	2002	6,300	7,228	17,553	0.99	1.05	143%	6.2%	True	True	True
11	U Willamette Spring Chinook	Clackamas & McKenzie Rivers	Adults	2003		3,041	12,530	0.89	1.02	312%	15.2%	True	True	True
12	U Willamette Steelhead	Willamette Falls Dam Winter Run	Natural Adults	2004		3,961	9,541	0.93	1.02	141%	10.4%	True	True	True
13	LCR Fall Chinook	14 Early, Mid- and Late Fall Run Stocks	Adults	2000		20,698	NA	0.97	N/A	N/A	N/A	N/A	N/A	N/A
14	LCR Chum	Grays R. & Hamilton / Hardy Cr.	Adults	2003		2,114	1,776	1.02	1.00	-16%	-1.5%	False	False	True
15	LCR Steelhead	Lower Columbia ESU	Adults	2001		6,333	4,429	0.93	0.92	-30%	-0.8%	False	False	False
16	LCR Coho	Sandy & Clackamas Rivers	Adults	2003		822	3,027	0.92	1.02	268%	10.4%	True	True	True
17	L Wenatchee Sockeye	Lake Wenatchee Turnoff	Adult Escapement	2004		7,449	19,283	0.83	0.96	159%	15.2%	True	True	False
18	Okanogan R Sockeye	Okanogan R ESU	Adult Escapement	2004		17,211	36,665	1.02	1.09	113%	6.7%	True	True	True

Table 4. (Continued).

19	UCR Summer/Fall Chinook	Upper Columbia River ESU	Adult Escapement	2003	37,530	119,145	1.09	1.15	217%	5.7%	True	True	True

[1]Snake River sockeye returns of zero (1990, 1995, and 1997) were changed to 1 in order to avoid a geometric mean of zero

Key for Table 4

ESU: The ESU in which the spawning aggregation resides

Aggregation: Spawning aggregation used for trend, i.e. selected stocks or rivers, entire ESU, etc.

Trend type: e.g., total spawners, wild spawners

Most recent year: Most recent year of data available for the spawning aggregation

Geomean (1996-2000): Geometric mean based on years 1996-2000

Geomean (2001-recent): Geometric mean based on years post-2000

Trend Slope (1990-2000): Trend calculation used in recent BRT document based on 1990-2000

Trend Slope (1990- recent): Trend calculation used in recent BRT document based on 1990-most recent year

N/A: Means that the indicated quantity is not available, due to lack of data

% Change in geomean: The % change in the geomean between periods 1996-2000 and 2001-recent

% Change in trend: The % change in trend between periods 1990-2000 and 1990-recent

Change in trend +?: TRUE if % Change in trend is positive, FALSE otherwise

Change in mean +?: TRUE if % Change in geomean is positive, FALSE otherwise

Trend > 1?: TRUE if BRT Trend (1990-recent) is greater than one, FALSE otherwise

6 Figures

Figure 1. The relationship between redd density of Snake River spring/summer chinook (all redd surveys above Lower Granite Dam) and estimated wild adult spring/summer chinook counted at the dam from 1962 through 2003.

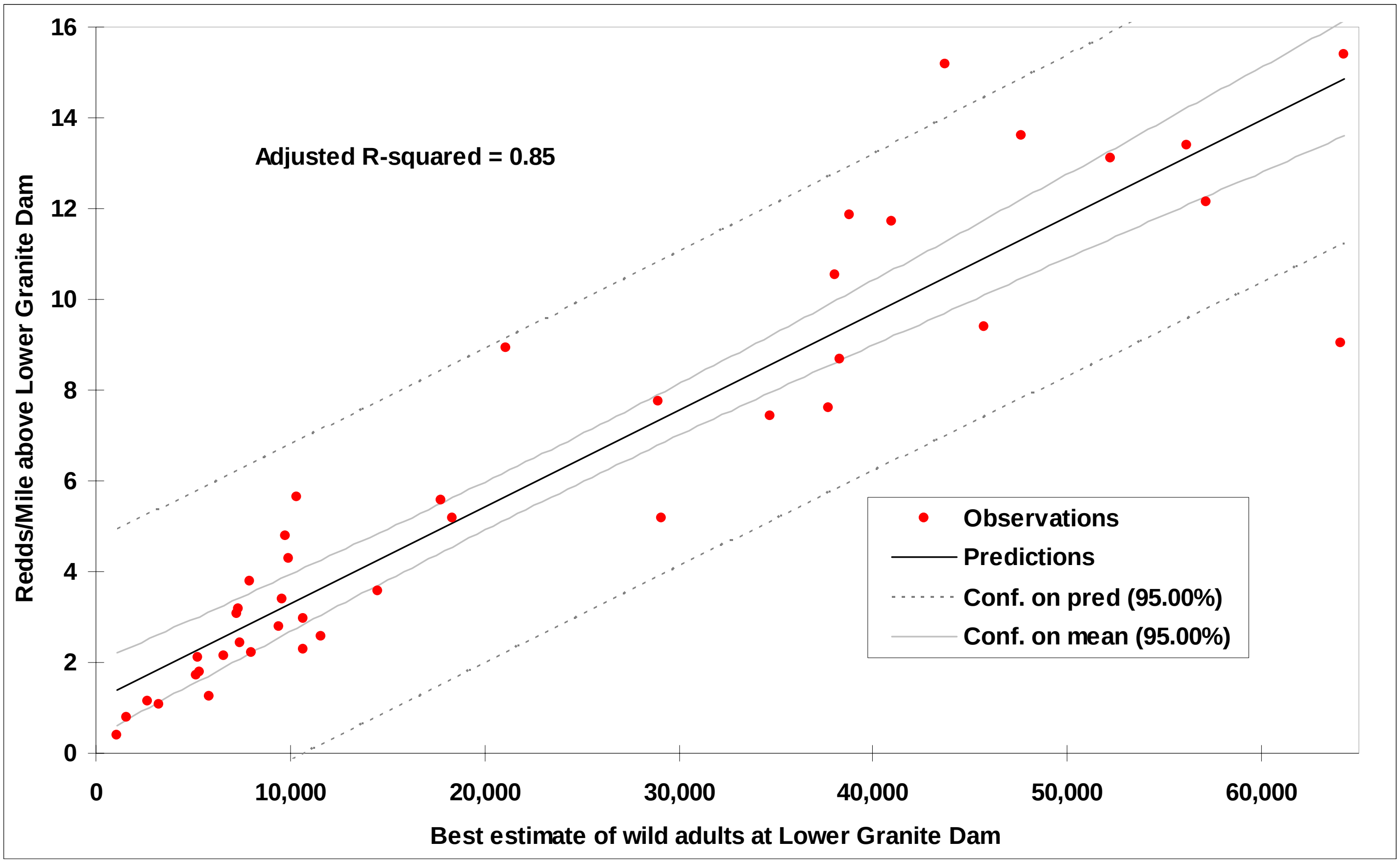


Figure 2. Abundance and 5 year geometric mean of abundance for the trends best representing each of the 19 ESUs. NOAA Fisheries interim recovery targets (if any were set) are also shown. Trends prior to the 1990 BiOp baseline are shown for informational purposes.

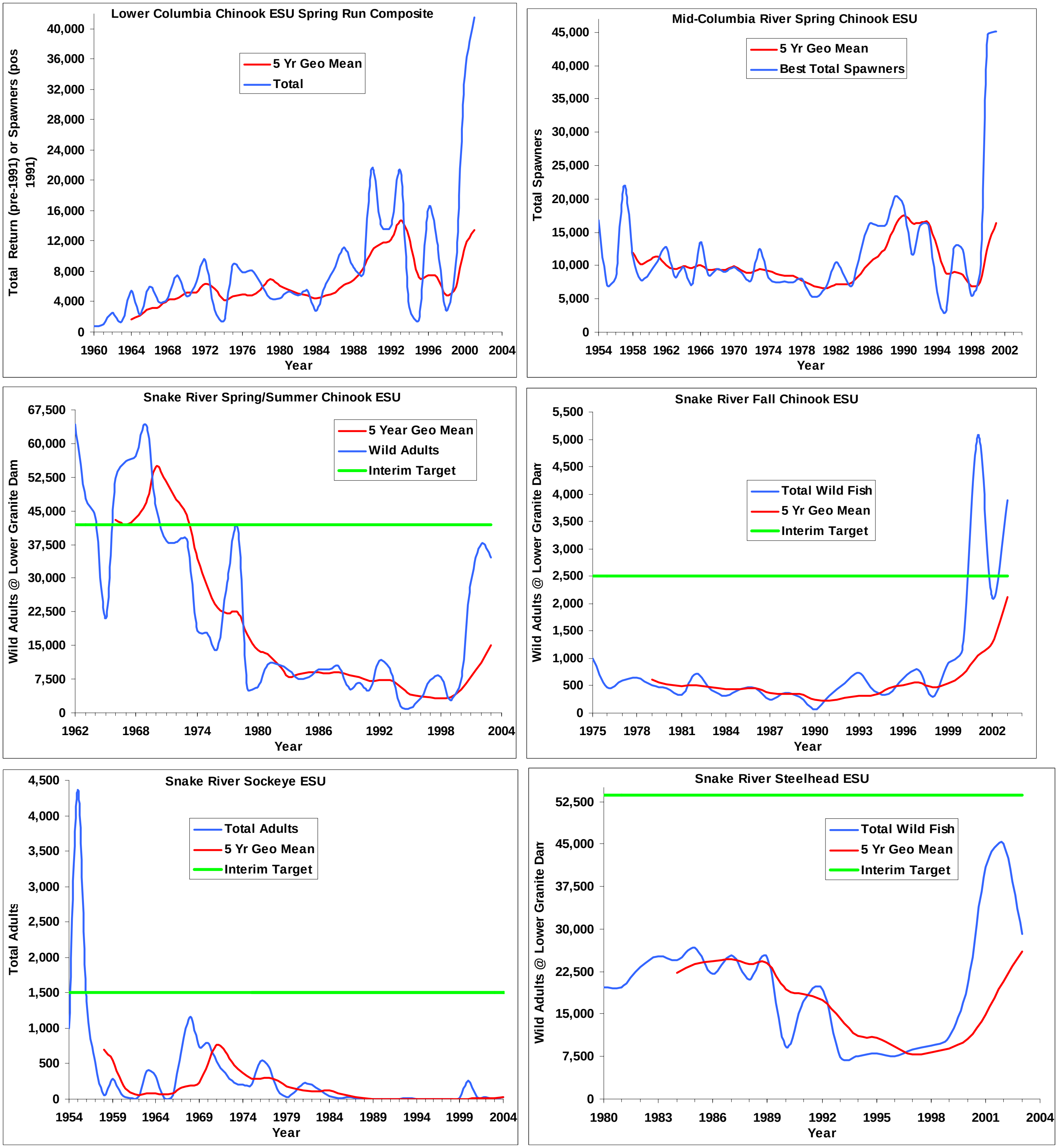


Figure 2. (Continued).

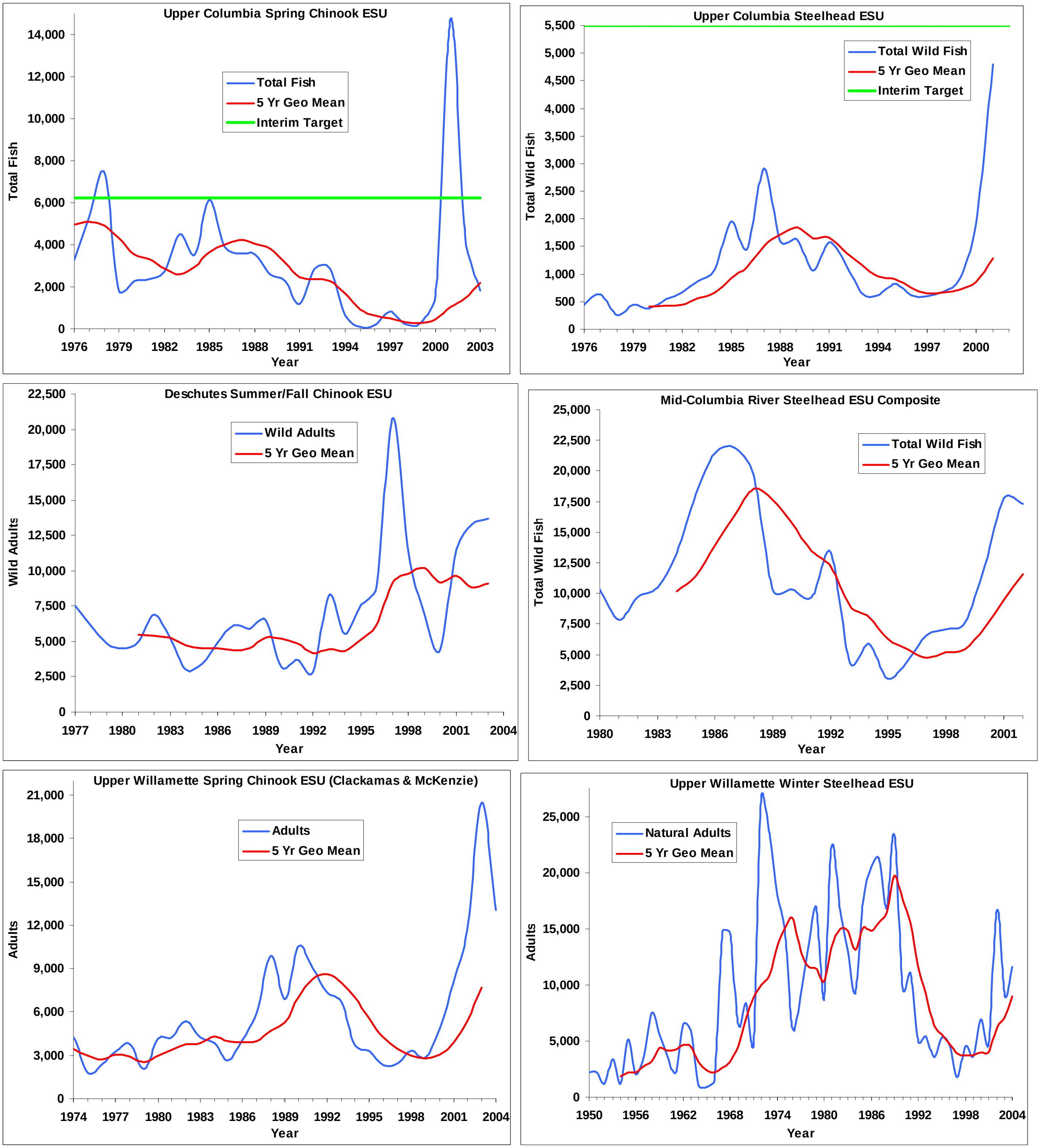


Figure 2. (Continued).

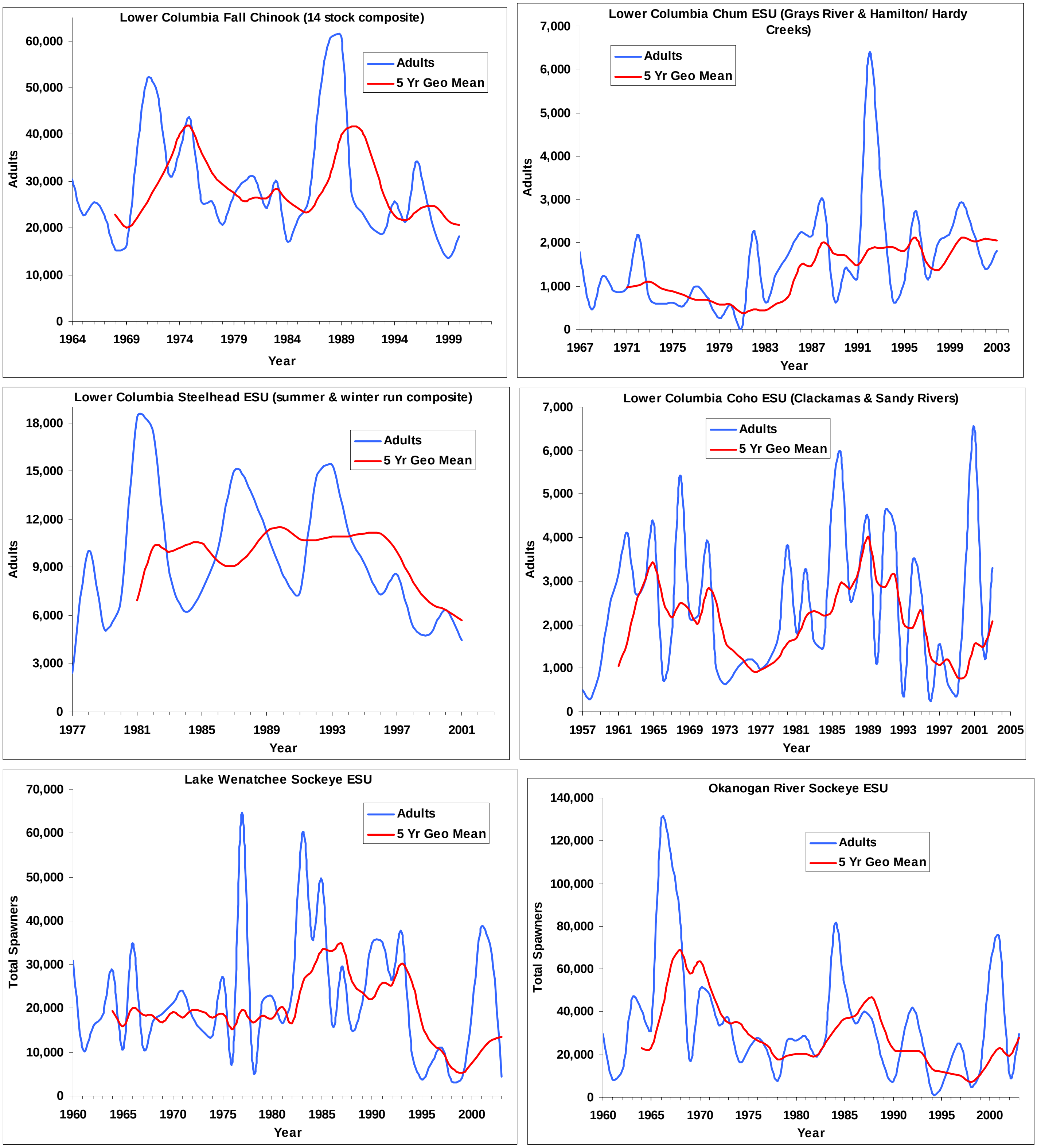


Figure 2. (Continued).

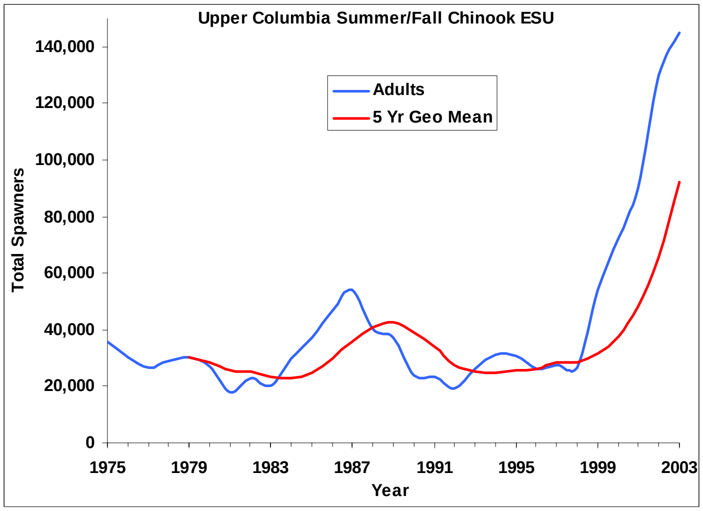


Figure 3. Percent change in mean abundance for 18 ESU trends from the base period (5 year geometric mean of 1996 – 2000) to the test period (2001 through the most recent year). We did not have post-2000 data to calculate the change for one ESU.

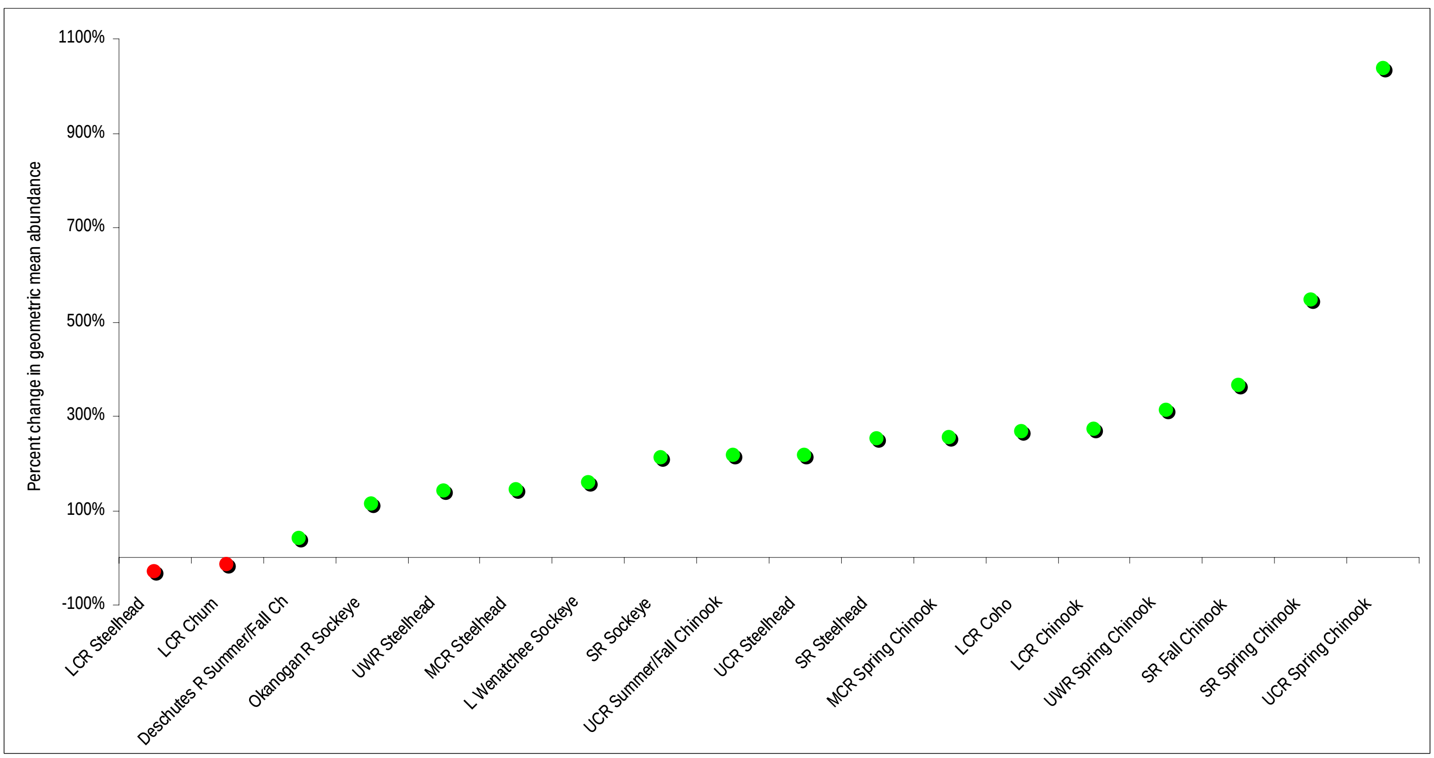
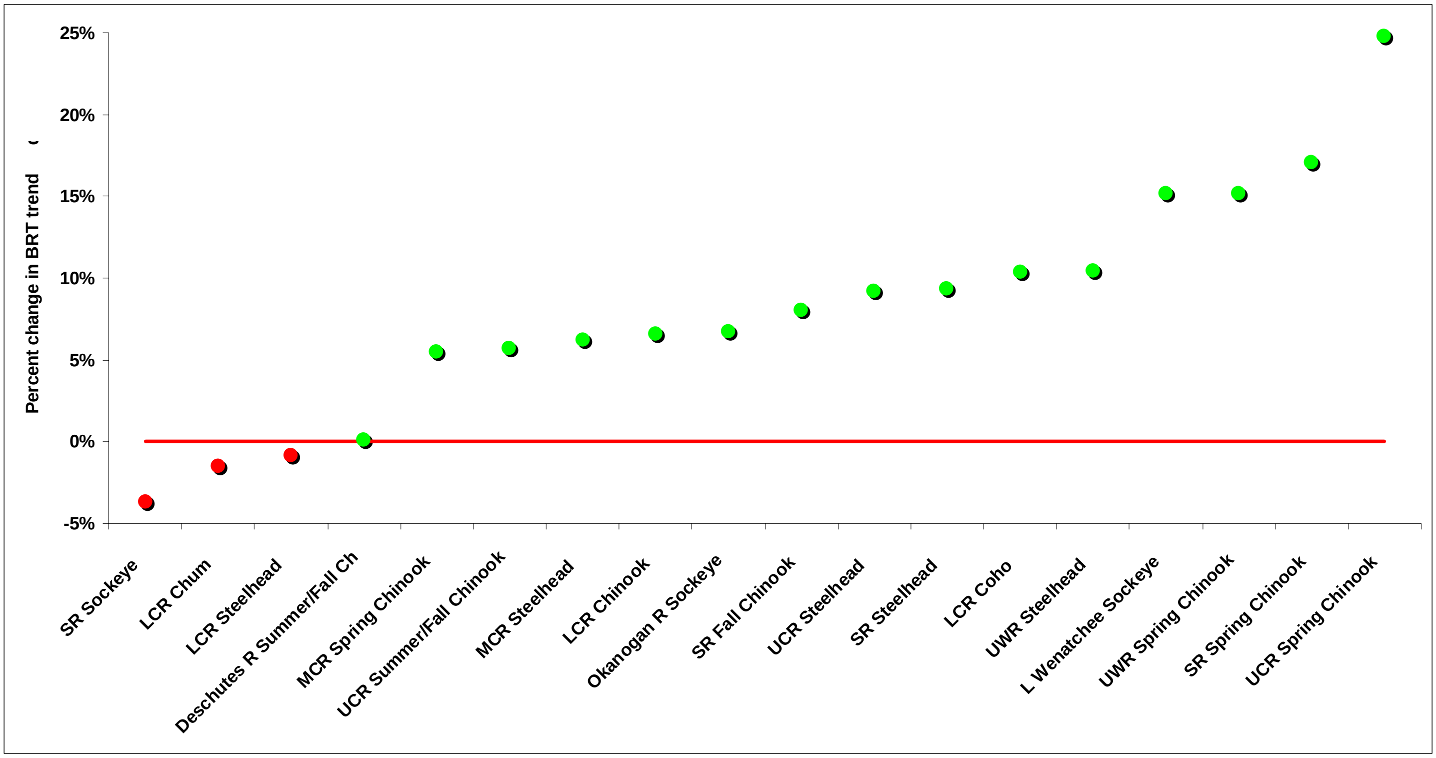


Figure 4. Percent change in the BRT trend for 18 ESU trends from the base period (1996 – 2000) to the test period (1990 through the most recent year). We did not have post-2000 data to calculate the change for one ESU.



7 References

(All appendices and reference documents not available on the WWW are available in a 16 MB ZIP file. Please email Tim@FisherFisheries.com for a copy of the appendices and reference documents.)

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8 Appendices

(All appendices and reference documents not available on the WWW are available in a 16 MB ZIP file. Please email Tim@FisherFisheries.com for a copy of the appendices and reference documents.)

APPENDIX A. Interim abundance and productivity targets for interior Columbia basin salmon and steelhead listed under the Endangered Species Act.

APPENDIX B. NOAA Fisheries BRT run reconstruction data

APPENDIX C. NOAA Fisheries Willamette/Lower Columbia Technical Recovery Team Trend Data

APPENDIX D. Run Reconstructions For The Ecosystem Diagnosis And Treatment Model

APPENDIX E. Various Trend Data

APPENDIX F. Escapement trends used in the tests

APPENDIX G. Charts for escapement trends, 5 year geometric means, and interim targets